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Western North Atlantic Humpback Whales

Kenneth C. Balcomb III and George Nichols

INTRODUCTION

From 1890 until 1970, approximately 1,200 humpback whales (*Megaptera novaeangliae*) were taken by whaling enterprise in the western North Atlantic Ocean; and from the cumulative catch data Sergeant (1966) has estimated the virginal population of that stock to number approximately 1,500 whales. Mitchell (1973) and Winn (1975) have conducted censuses and studies of this stock of whales in recent years in the feeding grounds off Labrador, Newfoundland, and Nova Scotia, and in the breeding grounds in the western central Atlantic. Their estimates for the number of whales in the feeding and breeding grounds range from 800 to 1,500, and it is assumed that it is the same stock that is being studied at both extremes of the migration, although there was no direct evidence of that being the case. To examine this problem of distribution and stocks of whales, the Fisheries Research Board of Canada conducted a 'Discovery' tagging study, in which 163 humpback whales were tagged in various areas of the western and central North Atlantic, and 41 whales were especially taken off Nova Scotia and Newfoundland to obtain returns (Mitchell, 1973). Only one tag was recovered (Mitchell, 1975), and it demonstrated a return to the same feeding area in consecutive years. No evidence was found to identify a feeding/breeding stock, though it is still supposed that such a correlation exists. More recently, other investigators (Katona, Brazier, Kraus, Perkins, and Whitehead) have been searching for photographic evidence of identifiable individual humpback whales in various regions of the habitat. To assist in this study, and to promote the development of non-lethal techniques in whale research, the Ocean Research and Education Society of Boston, Massachusetts, outfitted a research vessel *Regina Maris* for a long-term humpback whale study beginning in August 1976 and continuing through the calendar year 1977. This report describes the preliminary results of that study.

MATERIALS AND METHODS

Regina Maris is a 144-foot, three-mast barquentine, with accommodation for 36 people, and capacity for approximately 50 days at sea between ports. She has a wet laboratory, dry laboratory, library, and darkroom facilities aboard. During July–September 1976 and January–May 1977, the ship operated in the Newfoundland/Labrador and Caribbean areas, respectively, conducting censuses and photography of whales that were encountered. On each occasion that proximity and visibility permitted, high resolution 35 mm photographs were taken of identifying features (dorsal fin, flukes, flippers, etc.) of individual whales, by using motorized Nikon cameras and telephoto lenses of various focal lengths from 105 to 300 mm. Depending upon lighting conditions, Kodak Plus-X (ASA 125), Tri-X (ASA 400), and/or various kinds of color film were used. There were usually sufficient observer/photographers present during whale encounters to take many identifying photographs, with the result that reflections, shading, and varying angles of view could be interpreted in the analysis, and positive identifications of individual whales could be made.

In various definable areas where humpback whales were aggregated, strip censuses were conducted, using one to three observers aloft (height of eye, 80 feet), and two to five or more observers on the forward deckhouse (height of eye, 16 feet). During the censuses, the ship maintained speed (5 to 7 knots) and heading, as range and bearing was estimated and logged for each whale sighted. Repeat observations were noted, but of course not used, in calculating the density of whales observed. All observations were plotted, and density values were calculated for visibilities ranging from one to three nautical miles on either side of the ship, and for different subregions of the definable area. Acoustic recordings were made in the presence of humpback whales using an Aquadyne AQ-17 hydrophone on a 50 meter cable, and a Sony TC-152 stereo-cassette recorder, with system frequency response from 30 Hz to above 10,000 Hz.

RESULTS

During the July–September 1976 cruise, 81 humpback whales were seen in feeding grounds off the coasts of Newfoundland and Labrador. These sightings are plotted in Fig. 1. Due to the non-random distribution of whales seen during this cruise, strip census techniques were not considered practical. During the January–May 1977 cruise, approximately 200 humpback whales were seen in breeding grounds in the western central Atlantic (February/March), approximately 10 humpback whales were seen on migration past Bermuda (late April), and five humpback whales were seen on the feeding grounds in Massachusetts Bay (mid-May). These sightings and the ship's track are shown in Table 1 and Fig. 2. The whales were clearly not randomly distributed in the ocean, but their distribution on certain banks did lend itself to strip census methods of population estimation. Figs 3 and 4, and Table 2 present and summarize the strip census observations and results. We place higher confidence in the population estimate based upon a 2 NM survey radius, because it was reasonably certain that almost all whales were seen within 2 NM, but not within 3 NM of the ship. The resulting population estimate for Silver Bank in early March is 809 whales, of which 10.1% were calves of the year. In late March, the population estimate is 544 whales, of which 7.9% were calves of the year. We crudely estimate the number of whales at Navidad Bank in early March 1977 to be 96 whales.

These results are coincidentally quite similar to those of Winn *et al.* (1975); and, from our censuses and observations, we agree with those authors and Mitchell (1973) in

roughly estimating the population of humpback whales to number about 1,000 to 1,500 individuals in the western North Atlantic. The major mating and calving grounds for the stock(s) of these whales are on Silver and Navidad banks, where 85% (Winn *et al.*, 1975) to 90% (our data) of the breeding whales occur during the winter months. The major feeding grounds for the stock(s) are apparently along the continental shelf and banks off the east coast of North America, and along the coastlines of Newfoundland, Labrador, and Greenland. The preponderance of our observations in areas where water depths are 50 to 100 fathoms, or 'just off the edge' of the continental shelf, suggests a habitat preference or requirement for the species, though, obviously, deeper waters must be traversed during migrations.

The photographic results of the two cruises are still being analysed, but provisionally it can be said that the July–September 1976 cruise documented 18 recognizable fluke patterns, and 17 recognizable dorsal fin patterns from the 81 humpback whales sighted. During the January–May 1977 cruise, at least 9 recognizable fluke patterns and 23 dorsal fin patterns were documented in the Silver, Navidad, and Virgin Bank area, where approximately 200 humpback whales were sighted; and at least 5 fluke patterns and 7 dorsal fin patterns were documented near Bermuda for the approximately 10 whales sighted. One whale (Plate I) was photodocumented at Tooker Bank (52°N x 55°W) off Newfoundland on 19 August 1976, in the company of three other adult whales; and it was redocumented (Plate II) at Silver Bank (21°N x 70°W) on 11, 22, and 23 March 1977, with a newborn calf! This is the first direct evidence that we know about that demonstrates a feeding/breeding ground correlation for western North Atlantic humpback whales.

Approximately 30 hours of acoustic recordings were taped during the January–May 1977 cruise, with representative songs from the vicinity of Barbuda, Anguilla, Virgin Bank, Culebra, Navidad Bank, Silver Bank, and Bermuda. These tapes will be analysed by Katy Payne and Howard Winn for evidence of dialect, and for population estimates using the acoustic method of Winn *et al.* (1975). Results of those analyses will be reported upon at a later date.

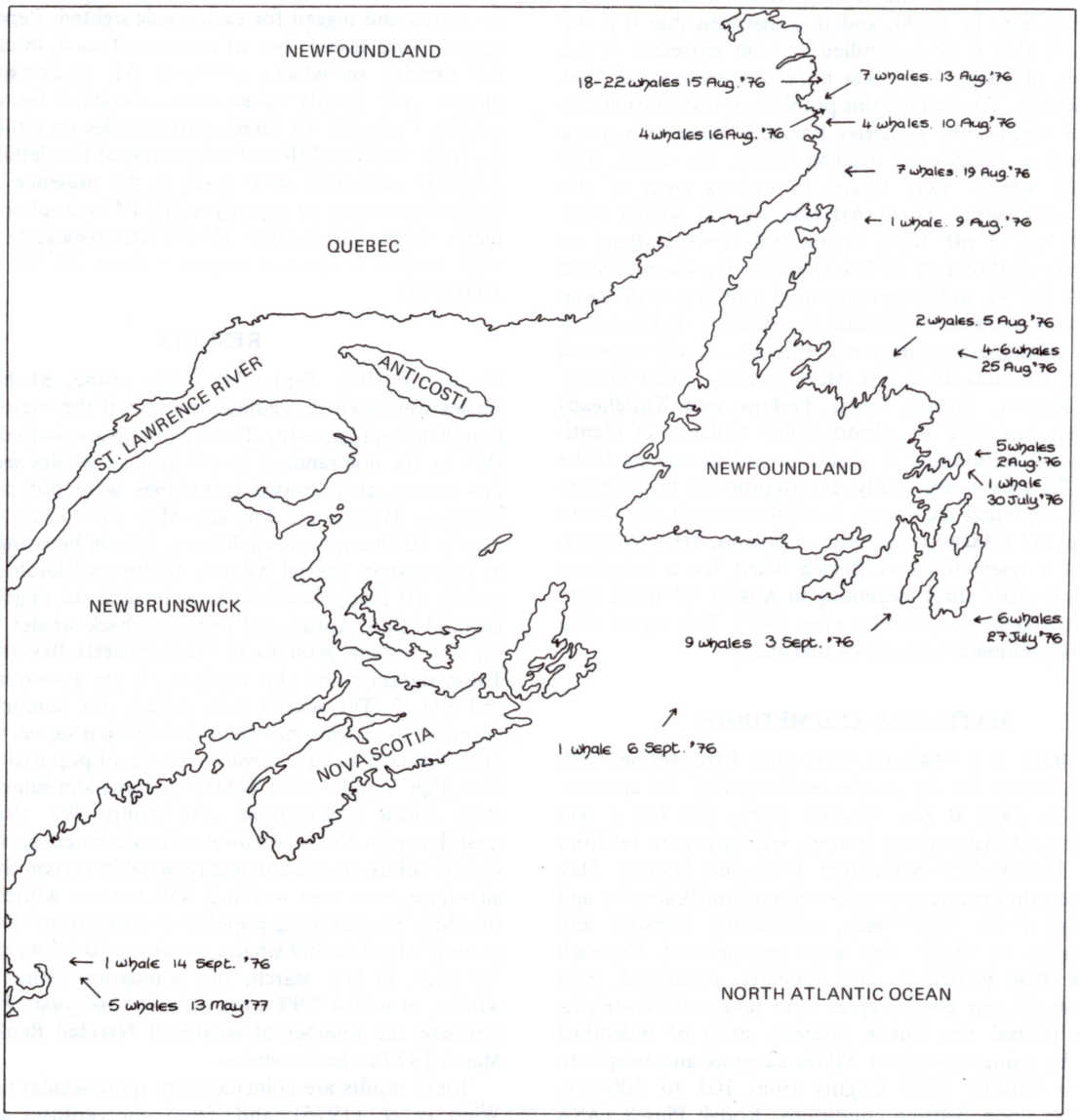
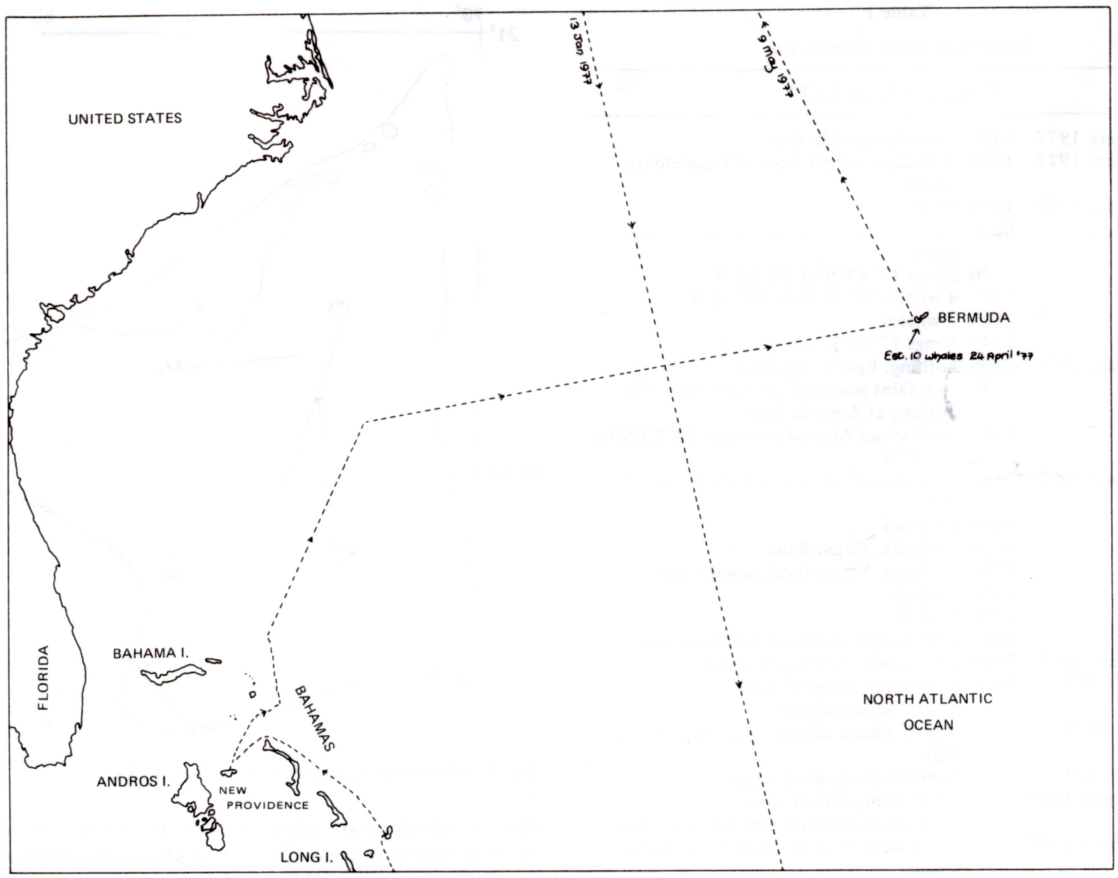
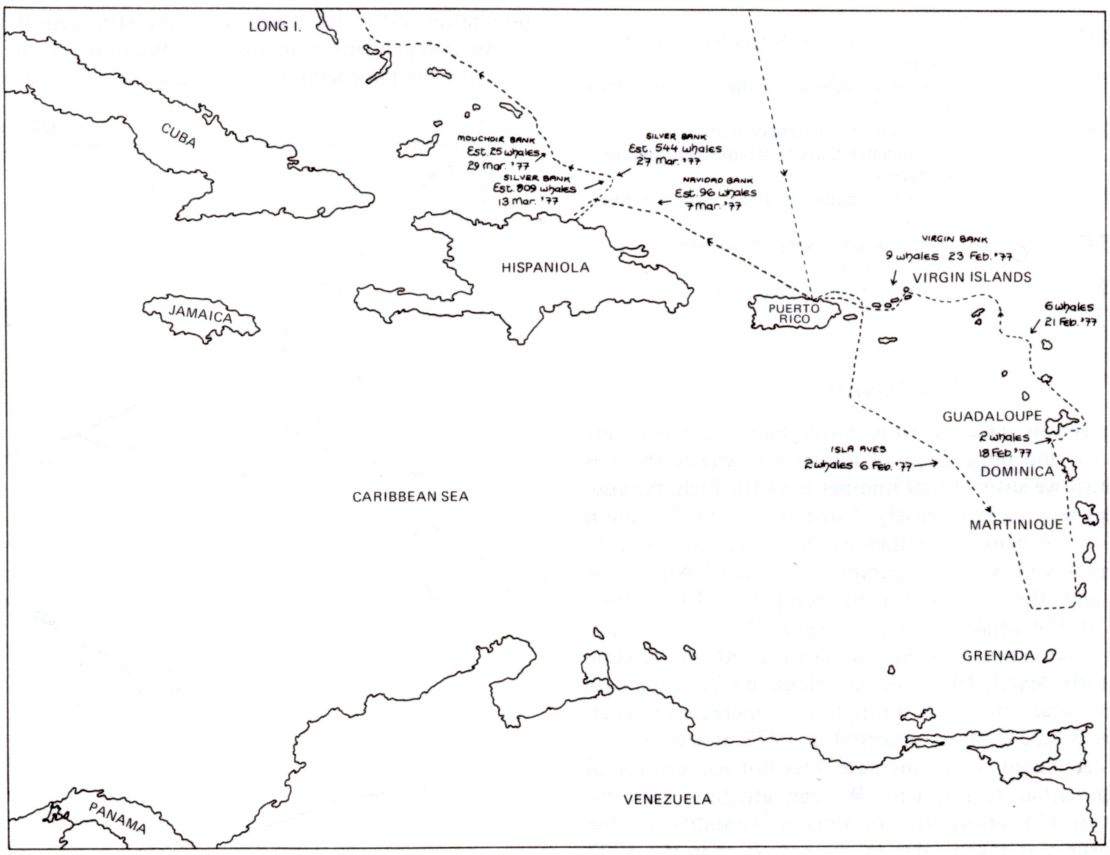


Fig. 1. Humpback whale sightings from the Newfoundland/Labrador area





Figs 2a,b. Humpback whale sightings 13 January–9 May 1977.

Table 1

Humpback whale information.

Cruise 1–77, and 2–77		
6 February 1977	1300	2 whales for Isla Aves
18 February 1977	1330	2 whales on bank East of Guadeloupe Island
19 February 1977	1030	blows
21 February 1977	0230	Songs 17°39′N by 62°08′W, heard all night
	1120	Songs 17°43′N by 62°13′W
	1245	4 whales 17°37′N by 62°16′W
	1610	2 whales
	1745	Songs 17°44′N by 62°37′W
22 February 1977	0700	nothing, East of Antigua
	1130	very faint songs 18°27′N by 62°57′W
	–	nothing at Anguilla Bank
	1915	weak songs Anegada Passage, 18°23′N by 63°30′W
23 February 1977	0730	2 whales 18°34′N by 64°19′W, Virgin Bank
	0810	no songs
	0920	3 whales, Virgin Bank
	1200	2 whales, Virgin Bank, good songs
	1540	1 whale
	1715	1 whale
	1850	weak songs, at anchor Virgin Gorda
27 February 1977	2115	weak songs, North of Culebra
6 March 1977	0620	good songs Navidad Bank
	–	lots of whales all day
7 March 1977	–	lots of whales all day, pop. estimate ca. 100
8 March 1977	–	Navidad Bank, good songs
9–13 March 1977	–	Silver Bank, lots of whales Population estimate 800 for Silver Bank
21–27 March 1977	–	Silver Bank pop. est. now 550, whales leaving
28 March 1977	1135–1454	12 whales, Mouchoir Bank, faint songs
29 March 1977	0950–1110	2 whales, Mouchoir Bank, pop. est. 25
24 April 1977	–	7 to 8 whales Challenger Bank, good songs
28 April 1977	–	5 whales Challenger Bank, 1 whale Gibbs Hill
29 April 1977	–	strip census Challenger Bank 0, Plantagenet Bank 0. whales very patchy, transient
30 April 1977	–	4 whales Challenger Bank, pop. est. few dozen
4 May 1977	–	2 whales, good song, Plantagenet Bank pop. est. few.
13 May 1977	–	5 whales Massachusetts Bay

DISCUSSION

Our best census data are from Silver Bank, and our best estimate for the population of humpback whales there is 809, though we suspect that number is a little high, because the whales seemed less densely distributed in the Southern corners of the bank. Nonetheless, the visual census techniques employed were comparable to those of Winn *et al.* (1975), and the results can be compared. Using their estimate of 754 whales present on Silver Bank in February 1973, and our estimate of 809 whales present on the same bank in early March 1977, we can calculate a 7.3% increase in the four-year interim, or a simple 1.8% increase per year. Given the $\bar{x}$ 8.53% calves observed in 1977, it seems clear that the calculated simple increase does not account for all of the potential recruitment. We can attribute this discrepancy to: (1) census error or non-comparability; (2) the 1977 census was taken later in the season than the 1973 census, and some whales had left; or (3) density dependent

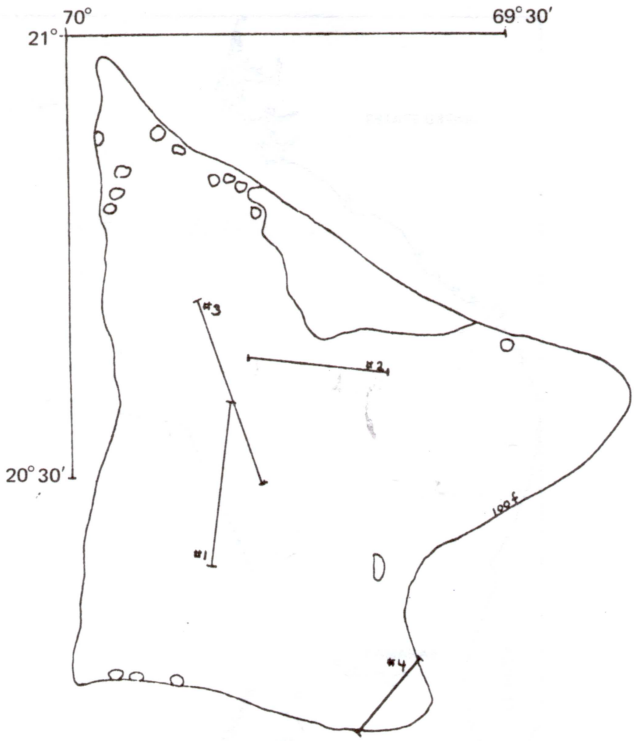


Fig. 3. Silver Bank. Censuses 1 through 4 tracks.

factors which may cause whales to move on to other suitable breeding areas. We do not know, but suspect # 2 to be the most reasonable explanation. At any rate, it is necessary to assess the degree of seasonal residency on various banks and grounds before we can be sure of our population estimates based upon the strip census method.

An independent estimate of population may be derived by using the photographic technique for statistical sampling

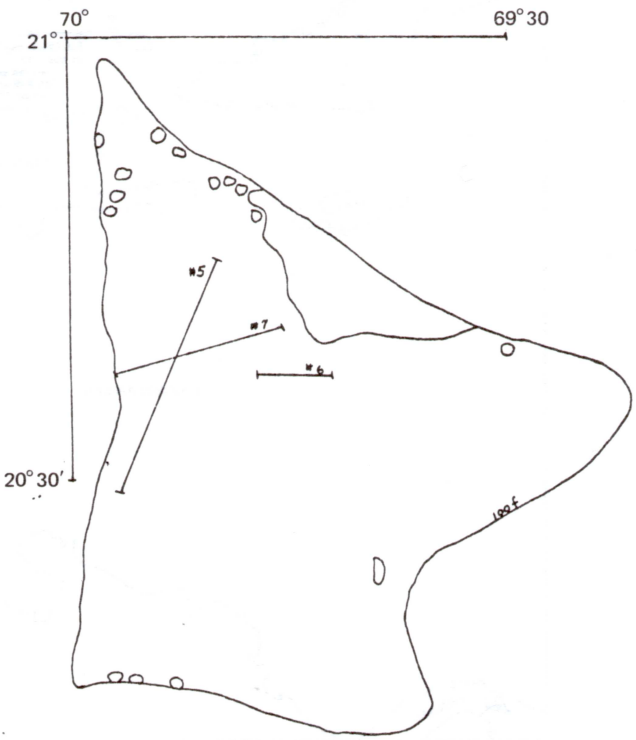


Fig. 4. Silver Bank. Censuses 5 through 7 tracks.

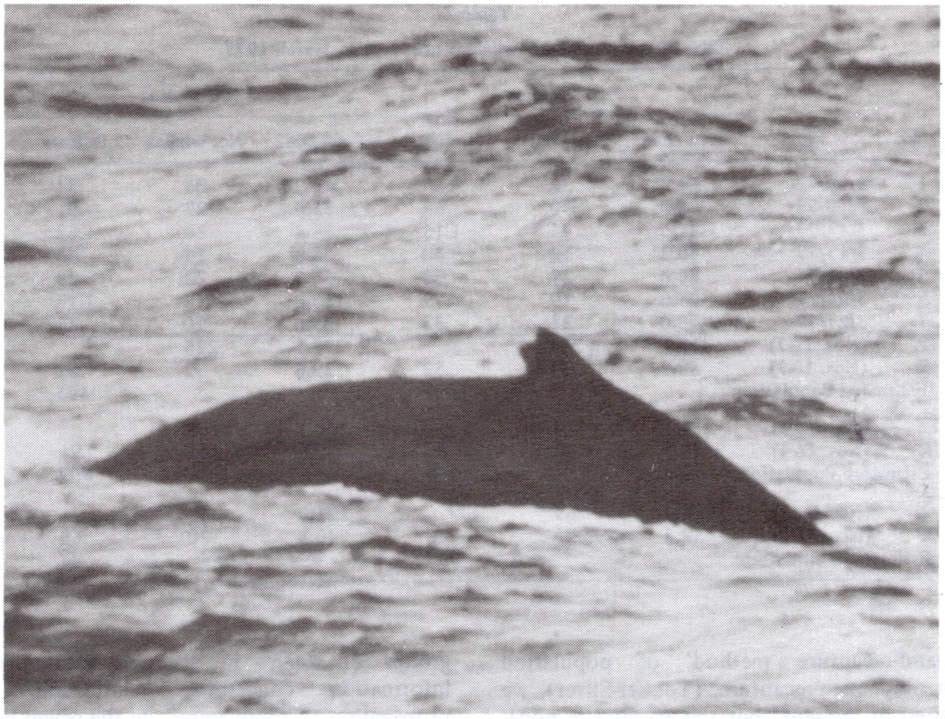


Plate I. Adult whale observed with three other adult whales at Tooker Bank (52N x 55W) on 19 August 1976.

Plate II. Same whale observed with calf and another adult whale at Silver Bank (21N x 70W) on 11, 22, and 23 March 1977.

Table 2

Silver Bank humpback whale census results, March 1977.

		3 NM Radius			2 NM Radius		
No.	Date	Area NM2	No. whales	Density	Area NM2	No. whales	Density
1	3/9/77	64.3	38	.59	42.9	36	.84
2	3/10/77	48.0	30	.63	32.0	29	.91
3	3/13/77	81.6	94	1.15	54.4	88	1.62
4	3/13/77	40.2	12	.30	26.8	12	.45
5	3/21/77	84.0	27	.32	56.0	22	.39
6	3/24/77	24.0	19	.79	16.0	18	1.13
7	3/27/77	70.0	23	.33	49.0	20	.41
Σ	(Nos. 1–7)	412.1	243		277.1	225	
$\bar{x}$	(Nos. 1–7)	58.9	34	.59	39.6	32	.82
Estimated Population:				*497*			*695*
Σ	(Nos. 1–4)	234.1	174		156.1	165	
$\bar{x}$	(Nos. 1–4)	58.5	43	.67	39.0	41	.96
Estimated Population:				*565*			*809*
Σ	(Nos. 5–7)	178.0	69		121.0	60	
$\bar{x}$	(Nos. 5–7)	59.3	23	.48	40.3	20	.64
Estimated Population:				*407*			*544*

in the 'mark-and-recapture method' of population estimation. With only one 'recapture' (Tooker-Silver), we are severely limited at present, but the method is nonetheless promising. Using Chapman's (1951) version of the Peterson method, $N = \frac{(M + 1)(C + 1)}{R + 1}$, and our data for the 1976 and 1977 cruises, we obtain (35 + 1) (44 + 1)/1 + 1, or 810 for N, and estimate close to the 1,000 to 1,500 estimated from strip census techniques (though it is coincidental with the sample size available). We mention the 'mark-and-recapture method' for its future value as we extend the sample size, and thereby improve its accuracy.

It is premature to discuss the significance of the Tooker Bank–Silver Bank whale, but it is a valuable record upon which to build our knowledge of distribution of stocks and substocks of western North Atlantic humpback whales. As Mitchell (1975) pointed out, 'the movements and interrelationships of Caribbean, Bermudan, eastern United States, Nova Scotian shelf, and Grand Banks humpbacks should be resolved at least in part before any proposals are put forth regarding population size and sustainable yields from stocks available . . .' The various investigators (Katona *et al.*) mentioned in the introduction are compiling additional records which will help illuminate these interrelationships.

The acoustic method of population estimate, as introduced by Winn *et al.* (1975) also seems to offer promise in humpback whale studies. Theoretically, there is no reason why a calibrated system could not be deployed in areas where whales sing; and, after determining the ratio of singing whales to non-singing whales, a respectable population estimate could be derived. Additionally, the prospect of determining dialectical differences in different groups of whales in different areas potentially yields information concerning relationships. Lastly, the propagation of these sounds in the ocean basins lends itself to direct monitoring and tracking of individual singing whales and groups of whales, when suitable equipment is developed. That, however, will probably not be available until around the turn of this century.

ACKNOWLEDGEMENTS

We sincerely acknowledge Dr. Howard Winn for his assistance in planning the January–May 1977 cruise of *Regina Maris*, and his thoughts on western North Atlantic humpback whales. We also appreciate the encouragement given by Roger and Katy Payne, Ollie Brazier, and Judy Perkins, who have pioneered the photo-technique of individual whale identification.

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